WHAT IS CLAIMED IS:

1. A method of forming a patterned thin film comprising:

depositing a thin film material on a surface of a substrate having thereon a patterned underlayer of a self-assembled monolayer.

2. The method of claim 1, wherein said substrate is selected from the group consisting of: a metal, a metal oxide, a semiconductor, a metal alloy, a semiconductor alloy, a polymer, an organic solid, and a combination thereof.

3. The method of claim 2, wherein said substrate is an irregularly shaped substrate.

4. The method of claim 2, wherein said substrate is a solid substrate having a flexible, curved or planar geometry.

5. The method of claim 1, wherein said self-assembled monolayer is prepared by a process comprising the steps of:

providing a stamp having a surface;

coating said surface of said stamp with an organic molecular species to produce a coated surface, said organic molecular species having a head functional group capable of interacting with said surface of said substrate, and a tail group for chemical

differentiation of said patterned and unpatterned regions of said coated surface;

placing said coated surface in contact with said substrate for a length of time sufficient to transfer said self-assembled monolayer of said organic molecular species from said stamp to said substrate; and

removing said stamp.

6. The method of claim 5, wherein said stamp is an elastomeric stamp.

7. The method of claim 5, wherein said stamp has at least one indented and at least one non-indented surface.

8. The method of claim 7, wherein said transfer is in a pattern defined by the topography of said stamp.

9. The method of claim 5, wherein said organic molecular species has a functional head group selected from the group consisting of: a phosphine, phosphonic acid, carboxylic acid, thiol, epoxide, amine, imine, hydroxamic acid, phosphine oxide, phosphite, phosphate, phosphazine, azide, hydrazine, sulfonic acid, sulfide, disulfide, aldehyde, ketone, silane, germane, arsine, nitrile, isocyanide, isocyanate, thiocyanate, isothiocyanate, amide, alcohol (hydroxyl), selenol (selenide), nitro, boronic acid, ether, thioether, carbamate, thiocarbamate, dithiocarbamate, dithlocarboxylate, xanthate, thioxanthate,

alkylthiophosphate, dialkyldithiophosphate, and a combination thereof.

10. The method of claim 5, wherein said organic molecular species has a functional tail group selected from the group consisting of: a hydrocarbon, partially halogenated hydrocarbon, fully halogenated hydrocarbon, phosphine, phosphonic acid, carboxylic acid, thiol, epoxide, amine, imine, hydroxamic acid, phosphine oxide, phosphite, phosphate, phosphazine, azide, hydrazine, sulfonic acid, sulfide, disulfide, aldehyde, ketone, silane, germane, arsine, nitrile, isocyanide, isocyanate, thiocyanate, isothiocyanate, amide, alcohol (hydroxyl), selenol (selenide), nitro, boronic acid, ether, thioether, carbamate, thiocarbamate, dithiocarbamate, dithlocarboxylate, xanthate, thioxanthate, alkylthiophosphate, dialkyldithiophosphate, and a combination thereof.

11. The method of claim 5, wherein said organic molecular species comprises one or more compounds selected from the group consisting of: a silane, a phosphonic acid, a carboxylic acid, a hydroxamic acid, a thiol, an amine, a phosphine, a hydrocarbon, partially halogenated hydrocarbon and a fully halogenated hydrocarbon.

12. The method of claim 5, wherein said said organic molecular species comprises (tridecafluoro-1,1,2,2-tetrahydrooctyl)trichlorosilane.

13. The method of claim 5, wherein said organic molecular species comprises octadecylphosphonic acid.

14. The method of claim 1, wherein said self-assembled monolayer is prepared by a process comprising the steps of:

contacting said substrate and a solution comprising an organic molecular species having a head functional group capable of interacting with said surface of said substrate, and a tail group for chemical differentiation, said contacting being at a temperature and for a length of time sufficient to bind said functional head groups to said surface of said substrate; and

exposing said self-assembled molecular monolayer to radiation modulated spatially in intensity with a mask having one or more regions transparent to radiation to chemically modify said self-assembled molecular monolayer in a chemically distinct pattern defined by said transparent regions of said mask.

15. The method of claim 14, wherein said radiation is light.

16. The method of claim 14, wherein said mask is a photomask.

17. The method of claim 14, wherein said contacting is carried out by immersing said substrate in said solution comprising said organic molecular species.

18. The method of claim 14, wherein said organic molecular species has a functional head group selected from the group consisting of: a phosphine, phosphonic acid, carboxylic acid, thiol, epoxide, amine, imine, hydroxamic acid, phosphine oxide, phosphite, phosphate, phosphazine, azide, hydrazine, sulfonic acid, sulfide, disulfide, aldehyde, ketone, silane, germane, arsine, nitrile, isocyanide, isocyanate, thiocyanate, isothiocyanate, amide, alcohol (hydroxyl), selenol (selenide), nitro, boronic acid, ether, thioether, carbamate, thiocarbamate, dithiocarbamate, dithlocarboxylate, xanthate, thioxanthate, alkylthiophosphate, dialkyldithiophosphate, and a combination thereof.

19. The method of claim 14, wherein said organic molecular species has a functional tail group selected from the group consisting of: a hydrocarbon, partially halogenated hydrocarbon, fully halogenated hydrocarbon, phosphine, phosphonic acid, carboxylic acid, thiol, epoxide, amine, imine, hydroxamic acid, phosphine oxide, phosphite, phosphate, phosphazine, azide, hydrazine, sulfonic acid, sulfide, disulfide, aldehyde, ketone, silane, germane, arsine, nitrile, isocyanide, isocyanate, thiocyanate, isothiocyanate, amide, alcohol (hydroxyl), selenol (selenide), nitro, boronic acid, ether, thioether, carbamate, thiocarbamate, dithiocarbamate, dithlocarboxylate, xanthate, thioxanthate, alkylthiophosphate, dialkyldithiophosphate, and a combination thereof.

20. The method of claim 14, wherein said self-assembled molecular monolayer comprises (tridecafluoro-1,1,2,2-tetrahydrooctyl)trichlorosilane.

21. The method of claim 14, wherein said self-assembled molecular monolayer comprises octadecylphosphonic acid.

22. The method of claim 1, wherein said thin film is deposited by a solution-based deposition process.

23. The method of claim 22, wherein said thin film material is selected from the group consisting of: an organic molecule, a short-chain organic oligomer, a long-chain organic polymer, a photoresist, an organic-inorganic hybrid material, a metallo-organic complex, a nanoparticle of metal, a nanoparticle of metal oxide, a nanoparticle of semiconductor, a silica particle, an inorganic salt, and a mixture thereof.

24. The method of claim 23, wherein said organic-inorganic hybrid material is selected from the group consisting of: $(C_6H_5C_2H_4NH_3)_2SnI_4$, $(C_4H_9NH_3)_2CH_3NH_3Sn_2I_7$, $(C_6H_5C_2H_4NH_3)_2CH_3NH_3Sn_2I_7$, $(H_3NC_4H_8NH_3)_2SnI_4$ and a mixture thereof.

25. The method of claim 23, wherein said photoresist is a positive working, deep UV photoresist.

26. The method of claim 23, wherein said long-chain organic polymer is polymethyl methacrylate/ methyl methacrylate copolymer.

27. The method of claim 23, wherein said metallo-organic complex is tin 2-ethylhexanoate.

28. The method of claim 22, wherein said solution-based deposition process is a spin-coating process comprising the steps of:

flooding said substrate having thereon said patterned self-assembled molecular monolayer with a solution comprising a thin film material or a precursor thereof; and

spinning to deposit said thin film material thereby forming a patterned thin film on said substrate.

29. The method of claim 22, wherein said solution-based deposition process is an immersion-coating process comprising the steps of:

immersing said substrate having thereon said patterned self-assembled molecular monolayer into a solution comprising said thin film material, or a precursor thereof; and

withdrawing said substrate from said solution, thereby forming a patterned thin film on said substrate.